# A NEW CRETACEOUS FISH.

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(Plates X–XI, Text-figures 1–3.)

The remains of vertebrates as yet described from the Lower Cretaceous deposits of Queensland are so few that considerable interest is attached to a large fossil fish presented to the Queensland Museum in August, 1931, by Mr. H. W. Denmead. This specimen was discovered one mile east of the township of Richmond, on the Flinders River, North-western Queensland. It not only adds another genus and species to the few Cretaceous fishes recorded for Australia, but, although very incomplete, it appears to exhibit certain combinations of characters which may be deemed significant to specialists in phylogenetic studies elucidating the classification of fishes.

**FLINDERSICHTHYS DENMEADI**, genus and species new.

*Material.*—The fossil consists of the head of a large teleost, with fourteen vertebræ, remains of the pectoral girdle, and a fragment of a pectoral fin. (Reg. No. F. 2210.) The specimen is nineteen inches (483 mm.) in length, ten and a-half inches (266 mm.) in height, and was approximately five inches thick (126 mm.) when received. The left side, which is considerably abraded in places, was fairly clear of superficial matrix when received, but the whole of the right side was heavily invested with a buff-coloured, fine-grained calcareous mudstone. Although much of the matrix was fairly soft, the exposure of the roof of the skull and the deeper elements, especially the basioccipital region, necessitated many hours of work. Several fragments of the common Lower Cretaceous shell, *Aucellina gryphæoides* (J. de C. Sow.) were found in the matrix.

*Principal Characters.*—Head large, laterally compressed. Breadth of cranial roof relatively narrow, with longitudinal depression in posterior region ; supraoccipital and epiotic feebly developed, but squamosal prominent ; cheek bones massive. Opercular apparatus and hyomandibular well developed ; gape wide, but not extending below orbital region ; upper jaw formed mainly by maxillæ. Jaws massive, well equipped with multiserial, villiform teeth ; cleithrum well developed. Centra of vertebræ completely ossified symmetrical cylinders, much deeper than long, marked with longitudinal striations between rims ; isospondylous. The external cranial bones are invested with ganoine.

The fossil denotes a large fish of robust proportions, provided with powerful fins (judging from the rudiment preserved of the pectoral). It was probably about four feet in total length, and in life may have weighed from 70 to 80 lb.

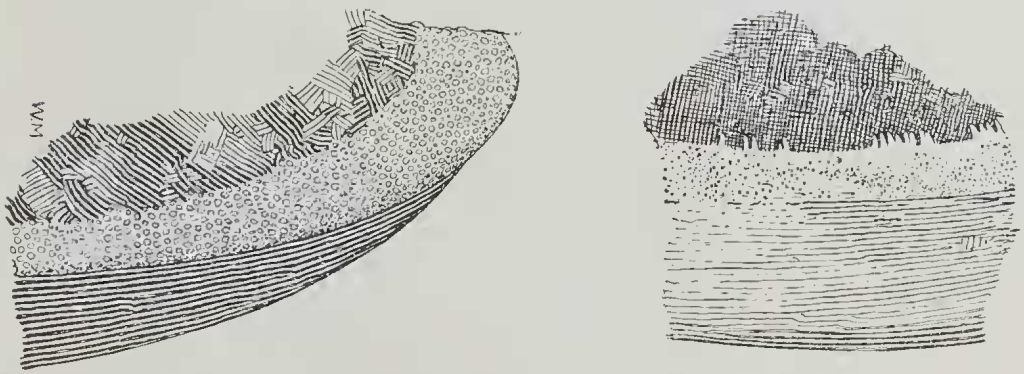
*Detailed description*—Cranium.—The specimen has been subjected to considerable distortion, especially on the right side, the roof of the skull having been obliquely crushed down, several of the elements have been displaced, and most of the bones are more or less abraded. (Plate XI, fig. 1). The supraoccipital is relatively very small, and is scarcely raised above the plane of the posterior border. Although the region is obscure, the parietals are considered to be small elements not separated by the supraoccipital, but its anterior small flange apparently underlies them slightly. The epiotic is feebly developed. The cranial roof, in its posterior region, exhibits a wide, quadrangular, median longitudinal depression, but this has probably been much exaggerated by strong pressure during fossilisation. It may be noted that a deep quadrangular pit in the cranial roof is a marked feature of species of *Thrissopater*, a genus of the Cretaceous Elopidæ from Cretaceous deposits in England. On the right side, a prominent feature is the large squamosal or pterotic bone, 110 mm. in length. The anterior portion of this bone has been forced upwards. The surface is distinctly marked with about eight smooth oblique furrows. Only a small posterior fragment of the left bone is preserved. In the anterior region of the right squamosal, the sphenotic or postfrontal forms a laterally projecting proecss (largely obscured on the left-hand side), which has an oblique trough in its median surface which passes downwards and backwards. This massive structure evidently formed a remarkable feature in the supraorbital region, perhaps as distinctive as that of the giant *Xiphactinus*, as described by Alban Stewart from the Upper Cretaceous of Kansas (1900). The roof of the skull is so much disrupted in places, however, that *Flindersichthys* may well have been preyed upon by one of the huge marine reptiles such as *Kronosaurus*, and it is difficult to interpret precisely its structure.

Between the orbital region and the occipital border, the roof, mainly comprised of frontals, appears to have been parallel-sided. The width at the occipital border was at least 75 mm., and it was apparently quite as wide between the orbits. Anteriorly, the cranium is distinctly narrower. The premaxillæ have been displaced. The most anterior element present in the roof is the unpaired mesethmoid, which is a stout bone with a median projecting process. On the left side the mesethmoid is in contact with an inwardly curved process, much abraded, of the maxilla. Fragments of the nasals with contiguous prefrontals are present. The vomer is apparently hidden in the cemented material in the upper part of the gape, and some of the many small teeth here present probably came from it. The bones in the roof of the skull in the prefrontal region are relatively thick, attaining about 8 mm.

As the result of long-continued work on the matrix on the right-hand side, portions of the basioccipital, exoccipital, and opisthotic are partly exposed, but the area is too obscure to permit of significant description.

*Mandibles.*—The massive character of the left mandible is shown on Plate X, but its anterior portion is incomplete. The right unit has been considerably displaced, and the whole bone has been thrust some 45 mm. backwards. Its anterior portion has been tilted up and now lies partly above the incomplete left unit. There is

evidence of a tumid extension in the anterior part of the symphysis. On the left mandible much of the lateral surface has been abraded, exposing an extensive area representing Meckel's cartilage. Fortunately the right mandible has been preserved, as exposed from the matrix, and it is no less than 230 mm. in length. It is relatively slender in its anterior portion, the lateral surface of which is prominently convex. The dentigerous area, as exposed, is a broad platform extending backwards for at least half the length of the bone. Anteriorly this area extends on a prominent wing-like process over the lateral border of the dentary. Numerous multiserial villiform teeth are preserved, many of which are *in situ*, but for the most part they are represented by a close-set mosaic of circular bases. Although most of the teeth were villiform, there is evidence of slightly larger units, which may be described as conical with somewhat curved tips, but all of these teeth are relatively very small. (Text-figures 1 and 2.)



Text-figures 1 and 2.—*Flindersichthys denmeadi*. Sections of mandible showing bases of villiform teeth exposed from matrix (partly diagrammatic).

The coronoid elevation is incomplete on the left side, but it is evident that it was prominent and in keeping with the massive proportions of the mandible. The preserved portion gives the left mandible a depth of 62 mm. in this region. The right coronoid is hidden in matrix. The area of the articular on the lateral surface is considered to be confined to the posterior fifth of the mandible, but the junction of the two elements is obscured. On the left side the actual articulating surface for the condyle of the quadrate is incomplete, and the right ramus shows that the posterior portion is curved upwards behind the actual fossa.

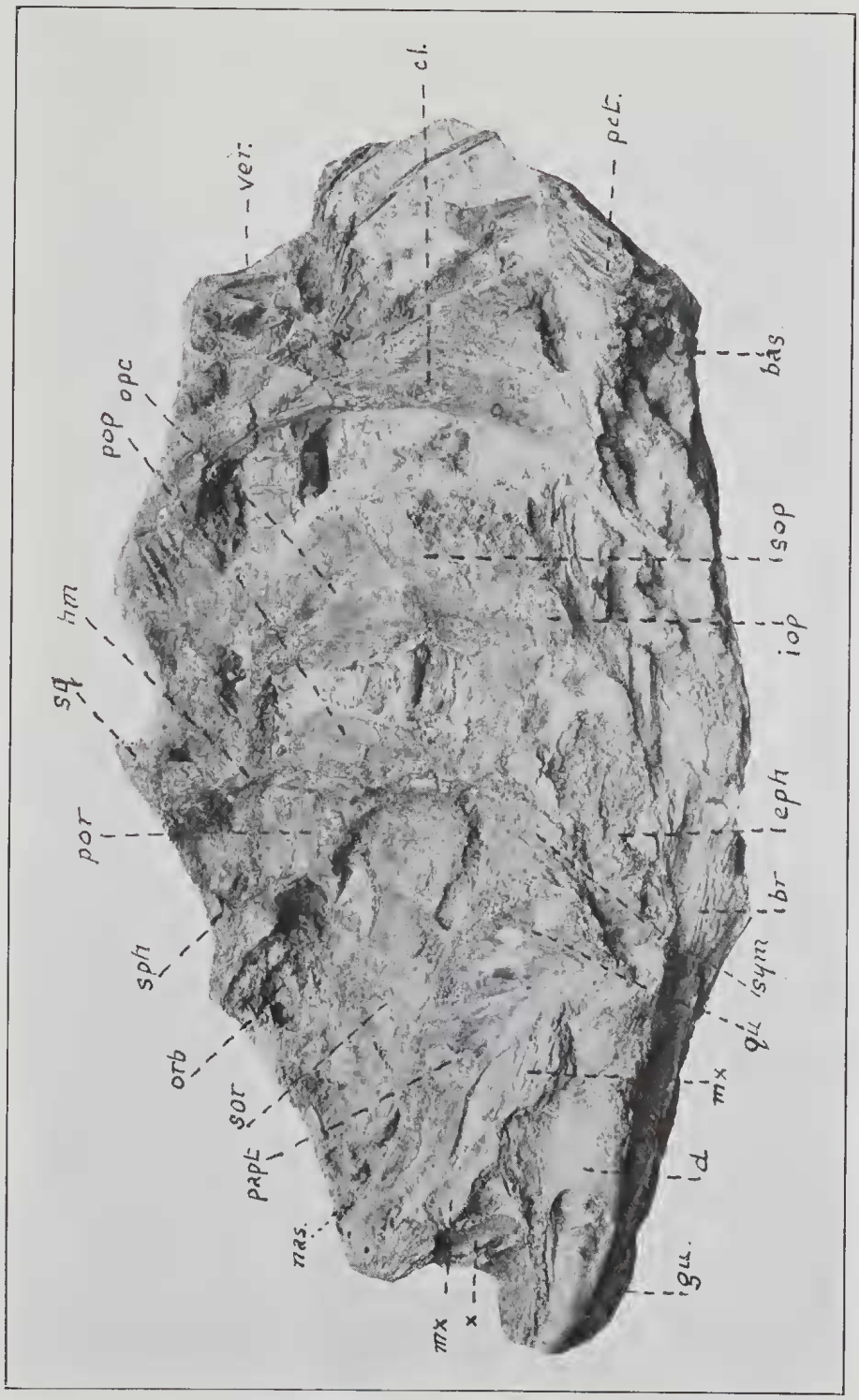
Within the gape is a displaced fragment from the upper jaw, 40 mm. in length, which exhibits a dentigerous area, slightly convex in transverse section, containing the bases of villiform teeth similar to those of the mandible. This fragment is almost certainly a portion of the left premaxilla. Judging from the dimensions of the mandible and the maxillæ, the premaxillæ were relatively small, curved elements, such as are characteristically found in Lower Cretaceous fishes.

*Maxillæ.*—The left maxilla is very incomplete and much abraded. Anteriorly it shows a prominent, inwardly-directed process, apparently terminating at its junction with the unpaired mesethmoid. The region above the maxilla, overlying the palato-quadrate bar, is so abraded that it cannot be stated whether supplementary or supra-maxillary bones were present. On the right side, exposed under deep matrix, the maxilla has been forced downwards and inwards on to the margin of the mandible. The length, as exposed in the matrix, is fully 188 mm., and the depth is approximately 25 mm. The anterior portion gives evidence of a pronounced inward and upward curve. The bone is gently curved throughout its length, and is somewhat convex on its lateral surface in transverse section. The depth is fairly uniform, but the bone was evidently thicker anteriorly. On the superior border there is a small elongated channel, which may have been associated with the bases of supramaxillary bones. Unfortunately the matrix on the oral border is extremely hard, and the bone cannot be further exposed. There is evidence of a close-set series of tiny conical teeth, which may be seen in the matrix. Within the anterior portion of the gape, the matrix is very hard, being evidently composed of the cemented detritus of disrupted bone, but numerous remains of villiform or minute conical teeth are more or less exposed.

*Quadrate and Symplectic.*—These two conjoined bones form a massive triangular plate. At the condyle the quadrate is no less than 20 mm. thick, thus forming a powerful hinge for the mandible. The right quadrate has been forced backwards and inwards, but its condyle is still in the articulating surface of the mandible. The condyle, as shown on the left side, has a pronounced inwardly-directed process, apparently as in *Oligopleurus vectensis*, as described by Smith Woodward (1890, p. 347.). The symplectic is closely associated with the quadrate on its supero-posterior border. The posterior edge of the symplectic passes beneath the lower portion of the hyomandibular, which partly overlaps it.

*Palatine.*—Articulating obliquely with the anterior border of the quadrate, and in the same lateral plane, is an elongated, curved bone, much abraded, which evidently represents the palatine with a pterygoid element closely adpressed. It terminates in the ethmoid region in juxtaposition with the maxilla. It may be mentioned that in *Arapaima*, according to Ridewood (1904, p. 73), the ectopterygoid is fused with the palatine. Inside this palato-pterygoid arch and below the suborbital plate a small portion of a mesopterygoid bone is exposed.

*Orbital region.*—Immediately above the quadrate and the palato-pterygo-quadrate arch, a massive plate of bone extends from the hyomandibular to the preorbital region. The natural surfaces are somewhat abraded, but it appears to consist of a single bone, extending to the lower border of the orbit. This plate is very thick and convex near the quadrate, but it shelves inwards in consonance with the narrowing of the cranium in its upper portion. The diameter of the orbit appears to have been about 40 mm. The actual region is partly filled with cemented detritus.




Flindersichthys desmeadi.

(*Approximately three-fifths natural size*).

*Explanation.*—*bas*, basals of pectorals; *br*, branchiostegals; *cl*, cleithrum; *d*, dentary; *eph*, ephyal; *gu*, gular plate; *hm*, hyomandibular; *iop*, interopercular; *mx*, maxilla; *nas*, nasal; *opc*, opercular; *orb*, orbit; *papl*, palato-pterygoid arch; *pop*, preopercular; *por*, postorbital; *qu*, quadrate; *sor*, suborbital; *sop*, subopercular; *sph*, sphenotic; *sq*, squamosal; *sym*, symplectic; *ver*, vertebræ; *x*, displaced dentigerous fragment.

*Photograph. W. J. Sanderson.*

*Face page* 92.

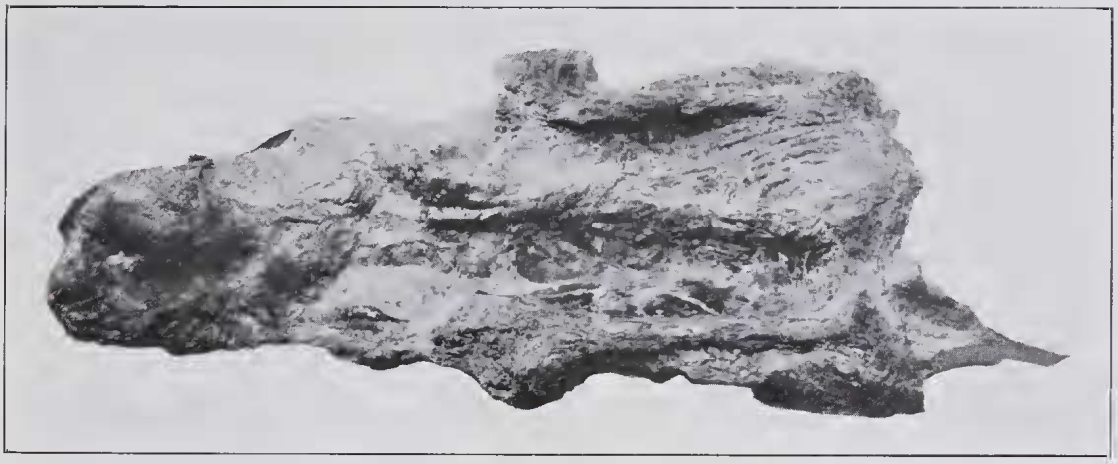


Figure 1.—*Flindersichthys denmeadi.*
Upper aspect of distorted cranium, as exposed from matrix.
(*Approximately one-half natural size.*)

Figure 2.—*Flindersichthys denmeadi.*
Lower aspect of mandible showing gular plate, anteriorly, and remains of branchiostegals.
(*Approximately five-ninths natural size*).

*Photographs : F. Jesson.*

*Face page* 92.

There is also an abraded plate in the post-orbital region, filling the space between the anterior branch of the hyomandibular and the lower sub-orbital plate.

*Ganoine.*—There is a distinct film of ganoine on most of the bones of the cranial roof, and there are small patches remaining on the other external cheek-bones, showing that these were enamelled. Where the ganoine is well preserved it gives a shining brown appearance to the fossil, and here and there are small patches with a bluish or opalescent tint similar to that on the large scales of our specimens of *Belonostomus*. (Ganoine is here used for a "layer of successive lamellæ of enamel-like, cell-less substance," as defined by E. S. Goodrich (1909, p. 218).)

*Hyomandibular.*—The vertical head, articulating with the pterotic region, is somewhat massive, and is much larger than the anterior head, which projects forwards to the sphenotic, some 50 mm. from the median line of the bone. The abraded outline of the bone is well marked on Plate X, and it will be seen that there is a more slender branch passing posteriorly to the operculum. Below the anterior and posterior branches, the lengthy median portion of the hyomandibular extends to the symplectic, and this portion forms almost a right angle to the series of vertebræ. Although this left-hand bone is much abraded, a displaced fragment of the right component, exposed from deep matrix, shows that the lateral surfaces of this large and complex bone were prominently flanged on the axes of the branches and that a thin plate of bone extended between the anterior and vertical heads.

*Opercular Bones.*—The posterior margin of the opercular is incomplete, but there is no evidence of radial furrows or striations or of a serrated border. The portion preserved is an extensive plate, considerably deeper than wide. There is an oblique suture between it and the subopercular, which is very incomplete, but this and the interopercular, represented by fragments, were evidently extensive plates. Only a small portion of the anterior plate of the preopercular is preserved, and this abuts on the median part of the hyomandibular. The exposed area between the hyomandibular and the operculum is now filled with white matrix and disrupted bones.

*Gular Plate.*—Between the mandibular rami in their anterior half is an extensive tongue of bone, which represents a gular plate. (Plate XI, figure 2.) This element was evidently paired, but owing to the displacement of the rami the area is somewhat obscure. The gular plate projects from the infero-lateral surfaces of the mandible and extends for about half the length of the rami, but it is much less robust posteriorly. In the anterior part of the symphyseal region there is evidence of a tumid extension of the mandible, which is now much abraded.

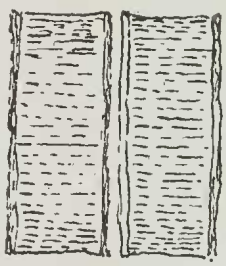
*Branchiostegals.*—Below the posterior third of the mandibles are the disrupted remains of large branchiostegal rays, and there are fragments of at least eight large rays present on each side. Behind these and below the quadrate there is a compressed cylindrical bone, which apparently represents the cerato-hyal and epihyal, with a well-marked suture between the two.

*Pectoral Girdle.*—The remains of the pectoral girdle form an extensive curved plate, about 50 mm. behind the opercular apparatus (Plate X). Unfortunately the

upper elements have been subjected to so much pressure that their articulations with the cleithrum cannot be defined. There is evidence, however, of a thin plate (supra- or post-temporal) that almost links the pectoral arch with the posterior margin of the cranium. Probably the whole arch has been forced posteriorly. The cleithrum (following the terminology of most modern systematists) is a very extensive bone, which carries the pectoral arch downwards and inwards. Although somewhat disrupted, this bone has a broad posterior flange in its central region, whilst the anterior margin is here very convex in section.

The remains of a large pectoral fin are present (Plate X), and at least six rays are preserved. These are bony and spine-like and are not segmented as in typical rays of Teleosts. In the matrix, near the base of the rays, are two large actinosts, which are somewhat constricted centrally, and, judging from their size, these supports would be few in number. Jordan (1905, p. 1) notes that in the Teleosts " the actinosts are few (four or six) in number," but they may remain numerous in the " Ganoids."

On the right-hand side, deep down in the matrix, a portion of the right pectoral girdle is present. The presence of a mesocoracoid cannot be determined.



Text-figure 3.—*Flindersichthys denmeadi*. Centra of vertebræ, natural size.

*Vertebræ*.—Probably fourteen vertebræ are present, but five of the series are hidden beneath the opercular and the scapular arches. The last two are only represented by the right-hand moieties of the centra. The vertebræ are completely ossified and symmetrically cylindrical (Text-figure 3). There is no evidence of even a minute perforation for a persistent notochord. The centra are deeply amphicœlous. They are more than twice as deep as long (30 mm. x 11). There are fine transverse striations between the anterior and posterior rims, which are thickened, the vertebræ being somewhat similar to those of *Oligopleurus vectensis*, as described and figured by Smith Woodward. Remains of the neural arches can be obscurely seen in the matrix over some of the centra, but these appear to have been relatively small. There is no precise evidence of actual anchylosis with the centra. The neural spines on the anterior vertebræ are well developed, attaining at least 80 mm.

This series of contiguous vertebræ has been pushed over somewhat to the left side of the fossil. The most anterior vertebra is close to the basioccipital region, which has been located in the matrix on the right side. This vertebra, which is almost certainly the first of the series, presents no evidence of division or of special

structure, and the whole series as preserved is isospondylous. Lateral pits do not appear to have been present.

Remains of ribs are adpressed to the vertebræ exposed behind the opercular, and these are attached just below the median line of the centra. Other remains of lengthy ribs are to be seen in the matrix below the last two vertebræ. The surfaces of some of the fragments, which have an enamelled appearance, are channeled. The actual method of their attachment is obscured.

The vertebræ are very distinct from those from Queensland concisely described and figured, but unnamed, by Smith Woodward (1894, p. 447.)

*Classification.*—In view of the special interest attached to the osteology of Lower Cretaceous fishes, a fairly full description of this Flinders River fossil has been attempted, although the condition of some of the bones has made this difficult. It is with considerable diffidence that the writer records tentative views as to its actual classification. The cranium of *Flindersichthys denmeadi* agrees in some respects with the general characters of the primitive Actinopterygii at the dawn of the Cretaceous era, as outlined by Smith Woodward in his introduction to Vol. IV of his great "Catalogue of Fossil Fishes." It affords another example of the difficulty of separating "Ganoid" and "Teleostean" groups. Unfortunately certain salient features used in diagnostic keys, such as those by Smith Woodward (1901, Part IV), and Tate Regan (1909 and 1929), cannot be verified in the fossil, and its affinities can only be suggested on the evidence of the complex of characters available. The status of the Order Isospondyli has been recently criticised by W. Garstang (1931) in his interesting study of phyletic classification, and Goodrich (1909, p. 370) writes that "the group can no longer be fitted into any phylogenetic scheme." It is convenient, however, to place *Flindersichthys* with its completely ossified, symmetrical vertebræ, in this assemblage, as the term Isospondyli is in such general use. Although the fossil cannot be positively allocated to any of the families of the Isospondyli with which comparisons have been made, it is tentatively placed in the Family Elopidæ. So far as the evidence is available, its complex of characters agrees fairly well with this group. W. G. Ridewood (1904, p. 54) has expressed the opinion that "the Elopidæ are the most archaic of existing Teleosteans," but adds that some of the extinct forms would seem to be more specialised than the living *Elops* and *Megalops*.

The presence of a gular plate in *Flindersichthys* is probably significant, but this is also characteristic of the Amiidæ, and other Amioidei. The massive structure of the sub-orbital bones do not suggest close affinities with the *Oligopleuridæ*, although the vertebræ are very similar. On the other hand the undoubted presence of ganoine is an anomalous condition for the Elopidæ. *Flindersichthys* does not appear to be closely related to the Leptolepidæ, so well represented in Jurassic deposits in Australia, in which the persistent notochord is evident in the centra. It appears to possess both Holostean and Teleostean characters. The Lower Cretaceous was evidently a period of rapid evolution for bony fishes.

Smith Woodward records (1912, p. 253) that some Cretaceous genera combine "features which are characteristic even of separate families in the existing fauna."

Among the Eugnathidæ he records *Neorhombolepis* and *Otomitla* as having vertebral centra as completely developed as those of *Amia*.

In view of the distinctiveness of the reptilian fauna of our Lower Cretaceous (dealt with by the writer in several papers in these Memoirs), it would not be surprising if this large Teleost has no close affinities with species found elsewhere, although the writer regrets that he has been unable to consult the full literature of the subject.

Smith Woodward has pointed out (1901, p. IX) "that stoutness of bones indicates a life in shallow water or at the surface of the ocean during the Cretaceous period."

It is obvious that *Flindersichthys denmeadi* was well equipped with broad bands bearing thousands of tiny teeth, and its diet was evidently very distinct from that of its contemporaries *Portheus* and *Ichthyodectes*, with their large, strong teeth, or from that of the slender-snouted *Aspidorhynchus* and *Pelonostomus*, described from the same deposits by Smith Woodward and R. Etheridge.

R. T. Wade (1930) has given a valuable review of the Fossil Fishes of the Australian Mesozoic Rocks, in which the literature of the subject is fully stated.

*Associated Fossils.*—Dr. F. W. Whitehouse, whose papers on our ammonite fauna are a notable contribution to Australian palæontology, has made the following note regarding the bivalve *Aucellina gryphaeoides* (J. de C. Sow.) :—"A cosmopolitan species with a range of Upper Albian to Lower Cenomanian, which has been found in Australia only in the Upper Albian beds of the Tambo Series of the Great Artesian Basin and the Point Charles Beds of the Northern Territory."

A series of much-abraded vertebræ, twenty-two in all, received from Mr. Robert Poole, Alderley *via* Hughenden, probably belongs to *Flindersichthys denmeadi*. (Reg. No. F. 986.)

*Acknowledgments.*—It is my pleasant duty to record keen appreciation of Mr. H. W. Denmead's action in securing this fossil at Richmond, bringing it to Brisbane and presenting it to the Queensland Museum. Two text-figures have been drawn by Mr. Wilfrid Morden. I must also thank the Director of the Australian Museum (Dr. C. Anderson) for the loan of a publication unobtainable in Brisbane, Mr. L. C. Ball, Chief Government Geologist for a volume from the Library of the Queensland Geological Survey, and the Queensland University Librarian, Miss E. K. McIver, for another volume.

## PLATE X.

### Flindersichthys denmeadi.

*Explanation.*—*bas*, basals of pectorals ; *br*. branchiostegals ; *cl*. cleithrum ; *d*, dentary ; *eph*, epihyal ; *gu*, gular plate ; *hm*, hyomandibular ; *iop*, interopercular ; *mx*, maxilla ; *nas*, nasal ; *opc*, opercular ; *orb*, orbit ; *papt*, palato-pterygoid arch ; *pop*, preopercular ; *por*. postorbital ; *qu*, quadrate ; *sor*, suborbital ; *sop*, subopercular; *sph*, sphenotic ; *sq*, squamosal ; *sym*, symplectic ; *ver*, vertebræ ; *x*, displaced dentigerous fragment.

PLATE XI.

Figure 1.—*Flindersichthys denmeadi*,
Upper aspect of distorted cranium, as exposed from matrix.

Figure 2.—*Flindersichthys denmeadi*.
Lower aspect of mandible showing gular plate, anteriorly, and remains of branchiostegals.

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# RESTORATION OF KRONOSAURUS QUEENSLANDICUS.

(Plate XII.)

In order to make more attractive the fragments of *Kronosaurus queenslandicus* exhibited in the Queensland Museum, a painting which suggests the appearance of this gigantic Cretaceous Pliosaur in a natural environment has been placed beside them. Plate XII is a much reduced illustration of this painting, but owing to the absence of colour it does not do justice to the original.

Owing to the incompleteness of our material, this restoration has been largely based on the skeleton of *Peloneustes philarchus*, as given by C. W. Andrews in his Catalogue of the Marine Reptiles of the Oxford Clay, published by the British Museum, part 2, 1913.

Although no claims for precise accuracy should be made for restorations of this kind, it is considered that the approximate contours are represented, and I wish to pay a tribute to the care and skill exercised by Mr. Wilfrid Morden, after making many preliminary sketches, in completing this work.

*Kronosaurus queenslandicus* was first described in 1924 (Mem. Qld. Mus., VIII, pt. 1) from a fragment of a lower jaw from Hughenden, presented by Mr. Andrew Crombie. Supplementary material was received in 1929 from the same district through Messrs. H. A. Craig, W. Charles, and N. E. Anderson, and this was described in 1930 (Mem. Qld. Mus., X, pt. 1).

Heber A. Longman.


Restoration of Kronosaurus queenslandicus.

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